**Supplementary Figure legends**

**Supplementary Figure 1.** Exhaustion-associated gene modules proposed by Daniel E. et al. Genes that have functional impacts on T cells are categorized into four modules (modules 1 to 4). TCR, T cell receptor; TGFβR, transforming growth factor‑β receptor; IL‑6R, interleukin‑6 receptor; PD1, programmed cell death protein 1; AP‑1, activator protein 1; BATF, basic leucine zipper transcriptional factor ATF-like; BCL6, B cell lymphoma 6; CCL3, CC-chemokine ligand 3; CDKN1B, cyclin-dependent kinase inhibitor 1B; CTLA4, cytotoxic T lymphocyte antigen 4; FOXP1, forkhead box P1; GZM, granzyme; HAVCR2, which encodes T cell immunoglobulin domain and mucin domain-containing protein 3 (TIM3); HSPA1A, heat shock protein family A member 1A; IFNG, interferon-γ; LAG3, lymphocyte activation gene 3 protein; LILRB4, leukocyte immunoglobulin-like receptor subfamily B member 4; NF‑κB, nuclear factor-κB; NFATC1, nuclear factor of activated T cells cytoplasmic calcineurin-dependent 1; NR4A, nuclear receptor subfamily 4 group A; PDCD1, which encodes PD1; RGS16, regulator of G protein signaling 16; STAT3, signal transducer and activator of transcription 3; TNFSF11, tumour necrosis factor superfamily member 11. Red represents upregulation of gene expression; Green represents downregulation of gene expression.

**Supplementary Figure 2.** Cluster analyses of expressing genes (reads count >1 at least in one single cell) from one patient (ID: P1116) in the single-cell sequencing data (GSE98638) of T cells infiltrating in HBV-positive HCC. Totally 9 distinct groups were clustered. T cells from PBMC (PTH/PTC/PTR) were clustered on the left part, whereas those from chronic hepatitis B liver tissues (CTH/CTC/CTR) and tumor (TTH/TTC/TTR) tissues were clustered on the center and right part, respectively. All regulatory T cells (PTR/NTR/TTR) were grouped on the top, T helper cells (PTH/NTH/TTH) in the middle, and CD8+ T cells (PTC/CTC/TTC) on the bottom.

PTH: peripheral blood T helpler cells (CD4+CD25-); PTC: peripheral blood CD8+ T cells; PTR: peripheral blood regulatory T cells (Treg cells, CD4+CD25high); CTH: T helpler cells (CD4+CD25-) from chronic hepatitis B liver tissues; CTC: CD8+ T cells from chronic hepatitis B liver tissues; CTR: regulatory T cells (Treg cells, CD4+CD25high) from chronic hepatitis B liver tissues; TTH: T helpler cells (CD4+CD25-) from HCC tissues; TTC: CD8+ T cells from HCC tissues; TTR: regulatory T cells (Treg cells, CD4+CD25high) from HCC tissues.